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UCRL-AR-220391-DRAFT

Draft Site-Wide Remediation Evaluation Summary Report for Lawrence Livermore National Laboratory Site 300

Executive Summary

April 2006

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This work was performed under the auspices of the U.S. Department of Energy by the University of California Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

Executive Summary

The U.S. Department of Energy (DOE) and Lawrence Livermore National Laboratory (LLNL) have prepared this Site-Wide Evaluation Summary report for LLNL Site 300 in accordance with the Site 300 Federal Facility Agreement Appendix A. LLNL Site 300 is a DOE high explosives experimental test facility operated by the University of California that supports the LLNL weapons program in research, development, and testing associated with weapon components.

This Site-Wide Remediation Evaluation Summary report assesses the protectiveness and effectiveness of the remedies that were specified in the Interim Site-Wide Record of Decision (ROD) for LLNL Site 300 (DOE, 2001). It was prepared to meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended by the Superfund Amendment and Reauthorization Act of 1986. This document provides the basis for a subsequent Proposed Plan and the Final ROD for LLNL Site 300. The Site-Wide Proposed Plan for the Remediation of LLNL Site 300 will propose, describe, and justify the preferred remedy for each operable unit (OU). After public and regulatory review and comment on the Site-Wide Proposed Plan, DOE will present the selected remedies and ground water cleanup standards in the Final ROD, scheduled for 2008.

Purpose

The purposes of this Site-Wide Remediation Evaluation Summary report are to:

- Develop remedial action objectives based on potential Applicable or Relevant and Appropriate Requirements (ARARs).
- Evaluate the effectiveness and protectiveness of the interim remedial actions and their suitability as final remedial actions.
- Identify any deficiencies in the interim remedies in their effectiveness, protectiveness, and/or ability to meet remedial action objectives and ARARs.
- Recommend changes to the interim remedies, as needed, to address identified deficiencies.
- Propose the final cleanup remedies for OUs 2 through 8.
- Evaluate the ability of the remedies to meet Maximum Contaminant Levels (MCLs) and other Water Quality Objectives (WQOs) for ground water to support the selection of cleanup standards in the Final ROD.

The report covers the following operable units at LLNL Site 300 that were included in the Interim Site-Wide ROD:

- Building 834 (OU 2).
- Pit 6 Landfill (OU 3).
- High Explosives (HE) Process Area (OU 4) including Building 815, High Explosives (HE) Lagoons, and the HE Burn Pit.
- Building 850 (OU 5) including the Building 850 Firing Table.

- Building 854 (OU 6).
- Building 832 Canyon (OU 7) including Buildings 830 and 832.
- The Site-Wide OU (OU 8) including Buildings 801, 833, 845, and 851 and the Pit 2, Pit 8, and Pit 9 Landfills.

This report does not apply to the General Services Area (GSA) (OU 1) because a final remedy and cleanup standards have already been selected for this OU in the Final Record of Decision for the GSA (U.S. DOE, 1997). The Pit 3, 5, and 7 Landfills, collectively designated as the Pit 7 Complex, are being evaluated through a separate, area-specific Feasibility Study and Proposed Plan. A remedy for the Pit 7 Complex area will be selected in an Amendment to the Interim Site-Wide ROD, and will be incorporated into the Final Site-Wide ROD. Buildings 812 and 865, and the Sandia Test Site areas are still undergoing characterization. If contaminant release sites that require remediation are identified, remedies to address contamination will be incorporated into the Final ROD through a ROD Amendment.

Methodology

The evaluation process used in this report generally follows the Five-Year Review process that is used to determine whether the remedy at a site is, or is expected to be, protective of human health and the environment (EPA, 2001). DOE/LLNL assessed the protectiveness of the interim remedies that were implemented in OUs 2 through 8 by determining if:

1. The interim remedies are functioning as intended at the time of the Interim Site-Wide ROD.
2. The assumptions used in the decision-making process are still valid.
3. Any additional information has been identified that would call the protectiveness of the interim remedies into question.

As part of this assessment, DOE/LLNL reviewed subsurface contaminant concentration data in ground water and soil vapor, and remediation system performance data through June 30, 2005 for OUs 2 through 8.

In addition, technical and logistical factors from the Contingency Plan for the Interim Remedies at Site 300 (Ferry et al., 2002a) that could affect the protectiveness and effectiveness of the interim remedies were also considered. The logistical factors considered in the evaluation included:

- Changes in land, surface water, and/or ground water use at Site 300 or the surrounding property that could affect the protectiveness of the remedy.
- Changes in the building or area use or access at Site 300 that could affect the risk assessment assumptions and/or institutional controls used to prevent exposure to contamination.
- Changes in ARARs.

In conjunction with the regulatory agencies, ARARs were previously identified for OUs 2 through 8 in the Site-Wide Feasibility Study for LLNL Site 300 (Ferry et. al., 1999) and the Interim Site-Wide ROD (DOE, 2001). The Interim Site-Wide ROD did not contain ground water cleanup standards. For this reason, any potential ARARs that applied to final ground water cleanup standards (i.e., the Basin Plan and State Water Resources Control Board

(SWRCB) Resolutions 68-16 and 92-49) were not included in the Interim Site-Wide ROD, except as applied to the operational aspects of the treatment technologies. As part of this Site-Wide Remediation Evaluation report, potential ARARs related to ground water cleanup standards were evaluated in anticipation of selecting these standards in the Final ROD.

The technical factors considered in this evaluation included:

- Progress of the interim remedies in reducing risk, contaminant concentrations, plume size, and impacts to ground water.
- Identifying any new sources, releases, or contaminants.
- Identifying any new technologies capable of more rapidly or cost-effectively achieving remedial action objectives and ARARs.

The technical and logistical factors were considered for each OU to assess whether: (1) the interim remedies, as implemented, are sufficiently protective and effective to prevent exposure to contamination and meet remedial action objectives and ARARs in a reasonable timeframe, (2) the interim remedy or components of the interim remedy require modification to be protective and effective, or (3) a new remedy should be implemented. Any deficiencies that would affect the protectiveness of an interim remedy were identified. Depending on the nature and magnitude of the deficiency, recommendations for modifications to the existing interim remedy or implementation of new remedies were proposed. If no deficiencies were identified, the interim remedy was recommended as the final remedy, unless a new proven technology was identified that was capable of achieving site cleanup more quickly and/or cost-effectively.

Because of the differences in the contaminant sources, contaminants of concern (COCs), plume migration pathways, risks, and interim remedies, the interim remedies for OUs 2 through 8, are discussed separately. Each OU discussion includes:

- Background information including an OU description, chronology of important environmental activities, hydrogeologic setting, history of contamination, COCs, and initial response.
- Descriptions of the interim remedial actions.
- An evaluation of interim remedy performance and protectiveness.
- A cleanup standard evaluation.
- Identification of interim remedy deficiencies, if any, and any potential changes to the interim remedies to address the deficiencies.
- The proposed final remedial action for the OU.

As agreed in the Interim Site-Wide ROD, DOE/LLNL also evaluated the economic and technical feasibility of achieving various potential ground water cleanup standards for the Final Site-Wide ROD by:

- Ground water modeling to determine the time and resources needed to achieve various potential ground water cleanup standards (i.e., MCLs, WQOs, background).
- Preparing cost estimates for ground water cleanup to MCLs, WQOs, and background.
- Evaluating the economic and technical feasibility of achieving these potential ground water cleanup standards to support the selection of cleanup standards in the Final Site-Wide ROD.

Evaluation Results

Tables Summ-1 and Summ-2 summarize the results of the logistical and technical effectiveness reviews of the interim remedies. As seen on Table Summ-1, this evaluation found that there have been no significant changes since the Interim Site-Wide ROD in ARARs or in land, building or ground water use at the site. The evaluation also showed that for the interim remedies in the Pit 6 Landfill, HE Process, Building 854, Building 801/Pit 8 Landfill, Building 845/Pit 9 Landfill, Building 851 and Building 833 areas:

- Progress has been made in remediating ground water, surface water, surficial soil, and the vadose zone (as applicable to each OU).
- Progress has been made in mitigating identified human health and/or ecological risks.
- No new sources, releases or contaminants have been identified.
- No new technologies that could accelerate cleanup have been identified.
- The interim remedies were found to be technically effective.
- No changes to the interim remedies are proposed.

In the Building 834 area, this evaluation found that remediation progress has been made in surficial soil, the vadose zone, and in mitigating identified risk. No new releases of contaminants were identified. However, remediation in the core area has not yet significantly reduced VOC concentrations in low permeability clay, and very long cleanup times are estimated. Enhanced bioremediation is currently being tested as a potential technology to shorten cleanup time. No changes are proposed in the interim remedy, pending results of the *in situ* enhanced bioremediation test.

In the Building 850 area, the cost of excavation and disposal of polychlorinated biphenyl (PCB)-, dioxin-, and furan-contaminated soil makes this remedy infeasible, and more cost-effective technologies have been identified to address these COCs in surface soil. Perchlorate has also been identified as a new COC in ground water in the Building 850 area. Changes to the interim remedy will be required to address the perchlorate in ground water and the contaminated surficial soil.

In the Building 832 area, vadose zone and surface/ground water remediation has progressed, and no new sources, releases or contaminants have been identified. Although the interim remedy is technically effective and no changes to it are proposed, vacuum-enhanced ground water extraction and expedited source area cleanup approaches are being evaluated to shorten cleanup time.

Monitoring will continue to evaluate a possible release of depleted uranium from the Pit 2 Landfill. Since the mechanism for mobilizing any depleted uranium has been removed, no change to the interim remedy in this area is proposed at this time.

This evaluation also found that all of the interim remedies are protecting human health and the environment, and no significant deficiencies were identified for the interim remedies. However, the very long estimated cleanup time at Building 834 has prompted the *in situ* bioremediation test in the distal (T2) area; additional wells may be needed in the future in the HE Process Area to fully capture the distal portion of the VOC plume in that area; and the Building 850 remedy will need to be modified to address the recent discovery of perchlorate in ground water above the Public Health Goal, and PCB-, dioxin- and furan-contaminated soil.

As agreed in the Interim Site-Wide ROD, DOE/LLNL conducted an evaluation to determine the technical and economic feasibility of achieving various potential ground water cleanup standards. The results of this evaluation will be used to support the selection of the ground water cleanup standards in the Final Site-Wide ROD. The evaluation results demonstrate the economic impracticability and very low cost benefit associated with attempting to reduce COC concentrations in ground water below MCLs to more stringent water quality objectives or background. The evaluation also concluded that a ground water cleanup standard of MCLs at Site 300 would be protective of human health and the environment.

Table Summ-3 summarizes the proposed final remedies for the OUs evaluated in this report. Except for continuing to evaluate bioremediation for the Building 834 area; assessing vacuum-enhanced ground water extraction and expedited source area cleanup approaches in the Building 832 area; and modifying the Building 850 remedy to address the contaminated surface soil and recently discovered perchlorate in ground water, the proposed final remedies are the same as the interim remedies.

Table Summ-1. Summary of logistical effectiveness review and institutional controls evaluation.

Area	Significant changes?			Is the interim remedy logistically effective?	Are institutional controls implemented and effective?	Are changes to the remedy needed?
	ARARs	Land, building, and ground water land use	Exposure pathways, toxicity, and other contaminant characteristics			
Building 834	No	No	No	Yes	Yes	No
Pit 6 Landfill	No	No	No	Yes	Yes	No
High Explosive Process Area	No	No	No	Yes	Yes	No
Building 850	No	No	No	Yes	Yes	No
Building 854	No	No	No	Yes	Yes	No
Building 832 Canyon	No	No	No	Yes	Yes	No
Building 801/Pit 8 Landfill	No	No	No	Yes	Yes	No
Building 845/Pit 9 Landfill	No	No	No	Yes	Yes	No
Building 851	No	No	No	Yes	Yes	No
Building 833	No	No	No	Yes	Yes	No
Pit 2 Landfill	No	No	No	Yes	Yes	No

Table Summ-2. Summary of technical effectiveness review.

Area	Is remediation progressing?				Have new sources, releases, or contaminants been identified?	Have new technologies been identified?	Is the interim remedy technically effective?	Are changes to the remedy needed?
	Surface soil	Vadose zone	Surface and ground water	Mitigating risk				
Building 834	NA	Yes	Yes. However, remediation in the core area has not significantly reduced VOC concentrations in ground water in the low-permeability sediments of the Tps clay HSU perching horizon.	Yes	No	*In situ* enhanced bioremediation technology is currently being tested in the T2 area.	The length of time necessary to achieve ground water cleanup standards using pump and treat technologies may be long due to: (1) low well yields resulting from the recharge-limited nature of the Tpsg HSU, (2) VOCs that will likely continue to diffuse from the low permeability Tps clay into ground water in the overlying Tpsg HSU, and (3) the limited ability of pump and treat technology to remove VOCs from low-permeability sediments in the Tps HSU.	No
Pit 6 Landfill	NA	NA	Yes	Yes	No	No	Yes	No
High Explosive Process Area	NA	NA	Yes. Additional extraction wells may be needed in the future to fully capture the distal VOC plume.	Yes	No	No	Yes	No
Building 850	The treatment of PCB-, dioxin-, and furan-contaminated surface soil has been delayed.	NA	Yes	The only risk is associated with surface soil.	Perchlorate is a new contaminant of concern.	More cost-effective technologies have been identified that are capable of addressing PCBs, dioxins, and furans in surface soil.	The cost of excavation and disposal of the PCB-, dioxin-, and furan-contaminated surface soil is economically infeasible.	Changes to the remedy will be required to address PCBs, dioxins, and furans in surface soil. DOE/LLNL will also discuss possible changes to the remedy to address perchlorate in ground water.
Building 854	Yes	Yes	Yes	Yes	No	No	Yes	No
Building 832	NA	Yes	Yes	Yes	No	Vacuum-enhanced ground water extraction and expedited source area cleanup approaches are being evaluated.	Yes	No
Building 801/Pit 8 Landfill	NA	NA	Yes	NA	No	No	Yes	No
Building 845/Pit 9 Landfill	NA	NA	NA	NA	No	No	Yes	No
Building 851	NA	NA	Yes	NA	No	No	Yes	No
Building 833	NA	NA	Yes	No	No	No	Yes	No
Pit 2 Landfill	NA	NA	NA	NA	Possible release of depleted uranium.	No	Yes	No. The mobilization mechanism for depleted uranium has been eliminated.

Notes:

HSU = Hydrostratigraphic unit. PCB = Polychlorinated biphenyl.
NA = Not applicable. VOC = Volatile organic compound.

Table Summ-3. Summary of proposed final remedies for the LLNL Site 300 OUs 2 through 8.

Building 834 (OU 2)	Pit 6 (OU 3)	HE Process Area (OU 4)	Building 850 Firing Table (OU 5)	Building 854 (OU 6)	Building 832 Canyon (OU 7)
Monitoring Risk and hazard management Extraction and treatment of ground water and soil vapor to mitigate risk and hazards posed by VOCs in the subsurface soil and protect and restore beneficial uses of ground water Continue to evaluate innovative technologies	Monitoring Risk and hazard management Monitored natural attenuation of VOCs and tritium in ground water	No further action for VOCs and HE compounds in soil and bedrock Monitoring Risk and hazard management Ground water extraction and treatment of VOCs at the leading edge of the Building 815 TCE plume; VOCs, HE compounds, and perchlorate from Building 815 and HE rinsewater lagoons; and VOCs, nitrate, and perchlorate from the HE Burn Pit Monitored natural attenuation of nitrate in ground water	Monitoring Risk and hazard management Monitored natural attenuation of tritium in ground water and surface water Source control through the removal and disposal of the contaminated sand pile Mitigate risk to onsite workers from exposure to PCB-, dioxin, and furan-contaminated surface soil in the vicinity of the Building 850. Exposure control measures may be implemented, if necessary, to prevent exposure to PCBs, dioxins, and furans in surface soil until soil is remediated Note: DOE/LLNL will discuss possible measures needed to address perchlorate in ground water with the regulatory agencies.	No further action for metals, high explosives, PCBs, and tritium in surface soil Monitoring Risk and hazard management Ground water and soil vapor extraction and treatment of VOCs, perchlorate, and nitrate	No further action for high explosive compounds in surface soil and nitrate in subsurface soil/bedrock at Building 830, and high explosive compounds in subsurface soil/rock at Building 832 Monitoring Risk and hazard management Controlling plume migration by extracting and treating ground water and soil vapor, both in the source area and at the leading edge of the Building 832 VOC, perchlorate, and nitrate plumes Controlling plume migration by extracting and treating ground water and soil vapor to remove VOCs, nitrate, and perchlorate at Building 830 Downgradient plume control by ground water extraction using an *ex situ* treatment of VOCs for the Building 830 area

Building 801, Landfill Pit 8 (OU 8)	B845 Firing Table, Pit 9 (OU 8)	Building 851 Firing Table (OU 8)	Building 833 (OU 8)	Pit 2 Landfill	
No further action for VOCs in subsurface soil at the Building 801 dry well Monitoring Inspecting the Pit 8 Landfill surface for damage that could compromise its integrity, and repairing any damage found	No further action for HMX and uranium in soil and bedrock Monitoring Inspecting the Pit 9 Landfill surface for damage that could compromise its integrity, and repair damage found	No further action for VOCs and uranium in subsurface soil and bedrock and for RDX, metals, and uranium in surface soil Monitoring	Monitoring Risk and hazard management	Monitoring Inspecting the Pit 2 Landfill surface for damage that could compromise its integrity, and repair damage found	

Notes:

HE = High explosive.
HSU = Hydrostratigraphic unit.
OU = Operable unit.
PCB = Polychlorinated biphenyl.
RDX = Research department explosive.
VOC = Volatile organic compound.

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